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ABSTRACT

Presented are papers by African scientists and policy experts discussing environmental law, policy, and science, relative to countries of Africa. Particularly emphasized are the concerns of environmental chemistry. An editorial comprises the first chapter. Subsequent topics include: (1) historical background of the African Regional Network for Environmental Chemistry; (2) reports of various environmental chemistry projects being conducted in Africa; (3) summary reports of workshops; (4) law and integrated environmental management; and (5) a list of references and upcoming meetings of interest. (RE)

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Special Issue on Environmental Chemistry

SCIENCE AND TECHNOLOGY EDUCATION NEWSLETTER

A Supplement to the Bulletin of the Regional Office for Science and Technology for

No. 10
December 1978

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UNESCO Regional Office for Science and Technology for Africa
Bureau Régional de Science et de Technologie de l'Unesco pour l'Afrique
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SCIENCE AND TECHNOLOGY EDUCATION NEWSLETTER

NO. 10 : DECEMBER 1978

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SPECIAL NOTICE

This number of the Science and Technology Education Newsletter is issued by the UNESCO Regional Office for Science and Technology for Africa in cooperation with the African Regional Network for Environmental Chemistry. UNESCO acknowledges with appreciation the work of Dr. S. O. Osibanjo, Department of Chemistry, University of Ibadan (Nigeria) in gathering material for this special number on environmental chemistry.

E D I T O R I A L

WHY WORRY ABOUT ENVIRONMENTAL POLLUTION IN AFRICA?

It would be useful to define certain terms before discussing the above subject matter. The ENVIRONMENT simply means man's surroundings, and includes "all those things which man comes in contact with and whose quality determines the quality of human life". POLLUTION may be defined as the "deliberate or accidental discharge, directly into the environment of energy (e.g. thermal energy) or substances (waste products) of human activities resulting in such deleterious effects as harm to water and land resources, hazards to human and animal health or upsetting the natural cycle of the ecosystem".

Thus POLLUTANTS are "substances released into the environment in sufficient concentration as to produce a measurable effect on the soil, plants, animals, humans or materials".

There is world-wide concern about environmental pollution. The technologically advanced countries of Europe, America and Japan have been expending a lot of money to combat pollution, having suffered a few unpleasant death incidents and the degradation of the environment caused by pollutant effects. We are justified in wondering if pollution of African waters is caused by the discharge from European coastal waters into our seas, since pollution caused by one particular country will inevitably spread to the coasts of other countries.

There is an erroneous assumption that environmental pollution is minimal or non-existent in Africa! While this may be true of the rural areas, can the same be true of the urban areas? There is a paucity of analytical data available to support or refute these assumptions. Undoubtedly, environmental problems would differ according to the state of development of the country concerned and this points up the importance of a global approach to the problem. We must set about gathering information that can help us answer such questions as these:

a) are the sources, types and effects of pollutants in Africa significantly different from those of the other parts of the world?

b) is the magnitude of pollution in the urban cities of Africa similar to that of their counterparts in Europe, Japan and U.S.A.?

The economy of nearly all African countries depends on agriculture. In the face of the population explosion on this continent, the food obtained from the land by the traditional agricultural practices is astonishingly insufficient to feed millions of hungry people. Fertilisers and pesticides imported from the developed countries are being used to increase food yield from the land. However, run-off of these chemicals from the land by rainfall into the rivers and lagoons pollute the environment. Analytical data is needed on the quantity and distribution of these chemical pollutants in the environment. Or, consider DDT, one of the pesticides that is widely used in Africa to eradicate malaria. Recent information from Guatemala, a Latin American country, where DDT has been used against mosquitoes for about 15 years, indicates that mother's milk contains DDT levels 15 to 500 times the "Acceptable Daily Intake" (ADI) established by WHO. What is the situation in African countries? It would be interesting to know the levels and distribution of DDT and other chemicals in the soil, rainfall, rivers food chain, wildlife and man. Studies on DDT and other pesticides and on their degradation products in the African environment are urgently required. Surely, the environmentalists of the world are looking forward to the day of pollution-free pesticides!!

African countries are trying to drop the tag "under-developed or developing nations" by industrialising at a fast pace. While this is most desirable, pollution caused by industrial wastes poses a serious threat to the quality of the environment. Japan in 1953 paid a very high price for industrial pollution, when many people became ill and 78 people were reported killed after eating fish contaminated with mercury. A plastic factory near

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the fishing village of Minimata Bay used mercury as a catalyst in its polymerisation process and discharged its waste directly into the bay waters. Fish absorbed the mercury in the waste and passed it to man along the food chain. How much of our fish is contaminated by untreated organic and inorganic industrial pollutants discharged into the rivers? What are the effects of these pollutants on the health of man? Fish are good indicators of pollution levels because certain exotic species survive only in very clean waters! We need to find out which African species are prevalent in clean rivers and then to classify rivers into different quality categories based on fish type.

The advent of technological and industrial development has considerably increased the number of urban cities in Africa. Unfortunately, most of these urban cities are poorly planned with inadequate drainage systems. Sewage treatment plants are non-existent and there is gross pollution of streams and rivers in the urban environments by raw sewage (domestic waste). It is not uncommon to sight faeces floating on rivers and lagoons! The sewage run-off pollution is making it difficult to provide the urban population with clean water (odourless and tasteless).

The coasts and beaches of some countries have been fouled by petroleum products discharged into the lagoons. Seas have been fouled by oil tankers that wash off oily sludge from their tanks or by accidental oil spillage. Oil on the sea is detrimental to the fishing industry and the ugly sight of black petroleum degrading beautiful recreational beaches could cripple the tourist trade for some countries.

Fortunately, some African countries have realised early enough that developing nations should not repeat the mistakes of the developed countries by allowing pollution to attain monstrous levels before taking remedial action. Attempts are being made to protect the environment by setting up "standards" along the pattern overseas, for the control and disposal of pollutants. Although this approach is laudable, is this measure relevant and appropriate for the African environment?

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For example, would it be reasonable to ban the use of DDT in Africa as had been done in some developed countries, bearing in mind that this pesticide is vital to our agricultural development programs? Does the level of lead in the African environment justify the abolition of leaded gasoline in motor vehicles as was the case in U.S.A.?

The answers to the numerous questions raised above can be provided by the collaborative efforts of African environmental chemists. In the short-term, there is an urgent need for (a) survey of the pollution sources in the African environment, (b) identification of the pollutants. (c) base line studies on the levels and effects of the various pollutants. The long-term objective would be the establishment of regionally applicable Effluent Standards and Environmental Quality Criteria.

If we start to monitor our environment now, the African continent will be in a position to know the quality of its environment before pollution levels become monstrous with rapid technological development, and can apply controls to make its environment relatively pollution free compared to the advanced countries.

We have got to start now!
Though the task is demanding
The cooperative efforts of the African Chemists
Backed with Governments/UNESCO assistance
Is the power we have got
If only we could use it
Our efforts would be rewarding
For the African and Human race

O. Osibanjo
Department of Chemistry
University of Ibadan
IBADAN
Nigeria

HISTORICAL BACKGROUND TO THE AFRICAN REGIONAL NETWORK FOR ENVIRONMENTAL CHEMISTRY

Scientists in the so-called developing countries of Africa, Middle East, Asia and Latin America tend to work in isolation under the most difficult conditions of inadequate research facilities, in terms of equipment and funds. Worse still, there is duplication of research efforts because of wide communication gaps among the scientists. Hence, scientists in these parts of the world are yet to make any impact on the societies in which they live. Their universities are regarded as "Ivory Towers" because of the questionable relevance of their research activities to the needs of the society.

Taking note of this isolation of gaps in communication among the scientists in Africa, delegates to the UNESCO-convened interministerial conference on the application of science and technology to development (CASTAFRICA) (Dakar, 1974) passed a resolution calling upon UNESCO to promote cooperation among these scientists in appropriately organized regional networks. UNESCO began at once to encourage scientists from Africa's universities to create a regional network that would mobilize their human and material resources to combat the social and economic problems facing theirr countries.

Finally, in September 1977, the deans of the faculties of science of nearly half the universities in Africa gathered in Nairobi as the Constitutive Assembly of the Association of Faculties of Science of African Universities (AFSAU). They adapted a constitution, elected a panel of officers, and outlined a programme of cooperation among science faculties in Africa in research, improvement of instruction and service to the community.

Following this AFSAU Assembly, representatives of chemistry departments of African universities agreed to create a framework for cooperation in environmental chemistry, an area of chemistry particularly relevant to African economic and social development. They organized the African Regional Network for Environmental Chemistry

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dividing it for reasons of economy into two sub-regional networks, one for countries in West Africa based on a coordinating centre at the Chemistry Department of Ibadan University and one for countries in East and Southern Africa based on a coordinating centre at the Chemistry Department of the University of Nairobi.

One of the objectives of this regional network is: "to organise workshops and seminars among participating institutions and to disseminate scientific information on research activities and the results of these by means of publications such as Newsletters to help increase general awareness of the Chemistry of the environment".

In March and April 1978, each of the coordinating centres organized a ten-day workshop on "Analytical Techniques in Environmental Pollution Monitoring" for participants in their respective regions. Brief reports of these two workshops appear on on page 15 of this Newsletter.

In July 1978, meeting in Yaoundé, Cameroun, the Executive Committee of AFSAU decided to set up a series of disciplinary committees in the basic sciences. The AFSAU Chemistry Committee was set up with the following officers:

- Professor M. Adjangba : Chairman/Convenor
- Professor E. H. Wright : Member
- Dr. B.L. Sondengam : Secretary
- Dr. P. Rasoanaivo : Member

The two Sub-Regional Networks for Environmental Chemistry were then incorporated as operational activities of the AFSAU Chemistry Committee, with coordinators as follows:

- Dr. S. O. Ajayi+ : Coordinator, West African Sub-Regional Environmental Chemistry Network.
- Dr. S. O. Wandiga : Coordinator, East African Sub-Regional Environmental Chemistry Network.

+ Formerly, Dr. O. Osibanjo

..../

Both sub-regional networks are again planning to organize laboratory workshops in 1979, the tentative dates for these being:

East Africa	23-27 July 1979
West Africa	30 July-3 August 1979

Scientists of African universities and research laboratories are invited to write to the appropriate coordinator regarding participation in the workshops.

THE CONTROL OF ENVIRONMENTAL POLLUTION BY THE UNIVERSITY OF MALAWI

Malawi is a land-locked country of approximately 45,000 square miles in area, about one fifth of which is water, the dominant feature being Lake Malawi, 355 miles in length and from 10 to 50 miles in width. The population is about 5.6 millions and the average growth rate is estimated to be about 3%.

The country is not well endowed with mineral wealth, but has a very progressive agricultural economy. The absence of concentrated large-scale industrial activity has meant that so far Malawi has suffered no serious pollution problems. However, with the population expansion, the modernisation and extension of agriculture and fisheries and an increase in industry, the long term effects of the potential concurrent environmental pollution problems are now the subject of serious consideration.

Following the 1976 Habitat Conference in Vancouver and the 1977 World Water Conference in Mar del Plata, Argentina, the World Bank and World Health Organization are currently operating a six-year programme to assess the water supply and sewerage needs of developing countries, and a study of these needs in Malawi has already been made.[1] In fact in January 1973 the Chairman of the Water Resources Board requested the circulation of a paper on the subject of water pollution, and after relevant legislation in European countries, Rhodesia and South Africa had been studied and advice sought from the United Nations Environment Programme and the World Health Organization, draft regulations appeared in July 1973. Eventually, in March 1978, the Water Resources (Water Pollution Control) Regulations were gazetted.

The efficient implementation of the control regulations involves the continuous surveillance of water supplies throughout Malawi and calls for the employment of a large number of people of varying technical qualifications, and also the provision of laboratory facilities. The immediate difficulty is a shortage of these requirements and this is where the University of Malawi, interpreting

[1] Republic of Malawi. Water Supply and Sewerage Sector Study, Vols. 1 and 2. World Health Organization/World Bank Cooperative Programme, 1978.

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its functions more broadly than in many countries, has seen an opportunity to help by offering the services of its Industrial Analysis Unit, a part of the Chemistry Department of the University. This Unit provides an analytical and consulting chemical service, and is already contributing to the monitoring programme. Since the beginning of 1975 the Unit has carried out regular check analyses of their large public supplies, and has also analysed many industrial effluents in these areas. Assistance has also been given in connection with the regulations, and some staff training in the theory and analysis of waters and waste waters has been undertaken. The Department welcomes this opportunity of emphasising to chemistry students the practical implications of their subject.

Environmental pollution due to the use of toxic chemicals in agriculture has also been a cause for concern, and the Industrial Analysis Unit undertook the monitoring of pesticide residues in tobacco in 1970 when consumer countries started to impose strict limits of permissible levels, until 1972 when this work was taken over by the Malawi Bureau of Standards. Future I.A.U. programmes include the monitoring of blood samples from workers engaged in the manufacture of batteries, for their lead content, and the analysis of water supplies for their fluoride content in areas where the incidence of dental fluorosis has been observed.

A REPORT ON ENVIRONMENTAL CHEMISTRY AT THE LABORATORY OF TROPICAL METEOROLOGY AND CLIMATOLOGY, YAOUNDE, CAMEROUN

M. Pelassy
Assistant
Faculty of Science
University of Yaoundé
YAOUNDE
Cameroun

The Laboratory of Tropical Meteorology and Climatology is examining the particulate matter of the atmospheric aerosol and the meteorological parameters that influence it. This study has been going on continuously for 3 years. In the first year, a sampling station was set up in Yaoundé with samples being taken on filter over 2 consecutive days. During the second year a second measuring station was installed in the rural area near Yaoundé (IRAF station at Nkilbisson) to evaluate the interactions between the town, as generator of local pollutants, and the rural site, which is subject only to large scale natural pollution sources (soil, vegetation, sometimes sea air). From that time samples have been taken daily. At present the partial analysis of the results of the first year has given rise to two publications:

1. "Characteristics of particulate atmospheric pollution in Yaoundé (Cameroun) during the very dry season of 1974/75 : its consequences for health", WHO Bulletin 1976. 54 No. 5 page 507/12 (in French).
2. "First characteristics of particulate air pollution in Yaoundé (Cameroun). Intertropical Front influence". To appear in "Atmospheric Environment" (in English).

The essential conclusions reported in these publications are:

1. The locality of Yaoundé and certainly vast sub-saharan areas are, at certain periods of the year, subject to very large pollution by particulate matter, inconvenient and even harmful to man, and this in the absence of any notable man-made pollution.

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2. At Yaoundé and certainly in a large part of the area of Cameroun situated south of the Adamawa massif, this pollution is no doubt influenced by the relief.

A chemical study of the major and minor components of the soil which no doubt constitute the major part of this particulate matter, is at present being carried out at the petrographic and geochemical research centre of Vandoevre Lès Nancy by quantometry, as no laboratory in Cameroun can at present undertake such a study of such small quantities of matter. Measurements taken over at least a year will be needed to distinguish the seasonal meteorological influences. These measurements are expected to yield results on background pollution.

In view of the first results, it would be interesting to extend the Yaoundé study to other sites in Cameroun, to at least three other stations for example: Garoua, or Maroua north of the Adamawa massif, Ngaoundere on the massif, Douala on the sea coast.

The mineral components of the air need to be correlated with the meteorological parameters. This chemical study of background pollution should extend to other components, for example, the organic fraction which must be considerable in the savana and forest zones. This would require the involvement of adequately equipped local chemists. The laboratories of Professor Wandji in Mineral Chemistry and Hajal in Physical Chemistry are prepared to take part in this work, which will require atomic absorption spectroscopy and fluorescent X-ray equipment.

Mr. Bisseck, Lecturer and Doctor d'Etat who has worked on characterising general circulation in the tropics and on line storms could give valauble help in interpreting phenomina of long distance transportation of materials such as the movement of the dry mist which causes the pollution maxima in these sub-saharan regions. Furthermore, Mr. and Mrs. Cautenet, lecturers interested in problems of propagation and diffusion from a hydrodynamic angle and in their statistical aspects, could also play a useful part in this study if they had low-layer radio-observation techniques using captive balloons, from the ground. In fact, the only radio-

observation available in Cameroun

...../
Cameroun

Cameroun is that of Douala meteorological station, performed daily at 12 noon, and the other observations carried out in various places in Cameroun are merely optical wind observations by pilot balloons.

Lastly, Mr. Lacase, lecturer, interested in radiation problems and studying solar heat in various sites in Cameroun, could extend his study to include particulate samples from various centres making possible a spatial study of the interaction energy received - quantity of material in suspension - obviously on condition that he too could extend his network of radiation measurements.

On the basis of the work done up to now by Mr. Pelassy, a study in environmental chemistry has already begun within the University of Yaoundé with the help of chemical techniques from outside Cameroun. The scientists at Yaoundé would like to extend their studies in environmental chemistry within the framework of the African Regional Network for Environmental Chemistry. They invite other scientists in Africa to write to them regarding possible cooperation.

SUMMARY REPORTS ON THE 1978 ENVIRONMENTAL CHEMISTRY WORKSHOPS : IBADAN (26 MARCH TO 3 APRIL) AND NAIROBI (6 TO 16 APRIL 1979)

The Ibadan workshop, convened at the Chemistry Department of the University of Ibadan, bringing together 7 participants from the 12 invited institutions in West Africa. The participants made a sampling trip to several nearby man-made lakes. Their measurements centred on analysis of heavy metals as contaminants in samples of water, river bottom sediments, fish, vegetables, and urine. Professor Soren Jensen, University of Stockholm, Sweden, served as visiting consultant on pesticide residue analysis.

The Nairobi workshop, convened at the Chemistry Department of the University of Nairobi brought together participants from six countries in the sub-region. They, too, made a field trip to collect samples for analysis. Measurements of heavy metals in the samples were made by atomic absorption spectroscopy and by polarographic methods. Professor Jensen served as the visiting consultant.

Both workshops, in addition to acquainting participants with appropriate analytical methods, served the useful purpose of establishing working relationship among scientists in the respective sub-regions. Each group expressed interest in continuing contacts among their members through exchange visits and joint research activities.

Commenting on his experience as the consultant to both workshops, Professor Jensen stated: "It is my opinion that the workshops served a useful scientific function, particularly as they brought together young scientists from a large variety of countries who normally do not have the opportunity to meet. The participants all had a very good theoretical background and seemed to be really motivated to tackle the future task of environmental pollution control. I also found that Dr. Osibanjo of Ibadan and Dr. Wandiga of Nairobi had done excellent work, and I am looking forward to cooperating with them in a future programme.

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"If the title of the workshops was changed to "An overview of environmental chemistry", I think that these were very valuable exercises and probably necessary before the start of a more detailed training and research programme. Through informal discussions we all learned the problems and difficulties in the different countries.

"In particular there was a general feeling among the participants that they were isolated from the scientific world as it often took years before articles of interest came into their hands. This drawback could rather easily be overcome if copies of lists from computerized literature searches could be sent to the two centres from where copies could be distributed to the members of the network. (Technical Information Clearing Centres).

"I also found that modern sensitive instruments were lacking in most countries;(1) the cause, I was assured, being lack of foreign currency. For the purpose of future work on environmental chemistry at least the two centres at Ibadan and Nairobi should be provided with support to enable them to buy them most modern gas chromatographs which should be automated in order to have a capacity to carry out work for the entire sub-region, i.e. purified samples from members of the network could be run on these instruments and the resulting chromatograms sent back to the customer. Funding for these instruments is a priority and the writer advises the network secretariat to examine all possible funding sources.

"The third drawback recognized during the first workshop was that the practical work had to be done in the existing laboratories normally used for students during their course work in both synthetic and macro-analytical chemistry. No rooms were available where the highly sensitive analytical instruments for residual analysis could be protected from dust and humid air.

"Finally, poor services facilities for instruments, and the lack of pure nitrogen for carrier gas were additional handicaps.

(1) See also S. Jensen and D. Odhiambo, Mission Report, December 1976.

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Professor Jensen then concluded as follows:-

Future Activities

All participants from both workshops declared that they were interested in future workshops in environmental chemistry, but perhaps more with the character of a training course. The length of this should be about ten working days, and should be specified to deal only with pesticide analysis and heavy metals in water, sediment and biological samples.

Personal conclusions

My participation in these first workshops in Ibadan and Nairobi showed me that the fundamental roles of the network are sound. Environmental chemical activities should be concentrated to specific problems, e.g. pesticide analysis. Every effort should be made to direct available skilled personnel to this network, including people from outside Africaa Thus a high level training programme can be implemented directed at the specific environment problems of the region.

The writer is willing to act as a consultant for the analysis of pesticides in the workshops at Nairobi and Ibadan in January or February 1979. However, he is not competent to cover the heavy metal analysis and recommends that a second consultant be recruited in this field for both workshops. However, I wish to clearly point out that these workshops cannot be operational unless:

1) the proper gas chromatographs are available at the two centres;

2) each centre must be capable of providing air-conditioned facilities in a clean room to house the instruments, and

3) a clean laboratory for the practical work is available.

LAW AND INTEGRATED ENVIRONMENTAL MANAGEMENT

H.W.O. Okoth-Ogendo
Department of Public Law
University of Nairobi
NAIROBI

(A lecture delivered to participants of an Environmental Chemistry Workshop, University of Nairobi, Chiromo Campus 5 to 15 April 1978).

PRELIMINARY REMARKS

During the past eight days this workshop has focused primarily on three things. Firstly, an attempt has been made to define what the domain of study - environmental chemistry - is. Without this one cannot really proceed. Secondly, alternative techniques for analysying and monitoring environmental issues have been examined and evaluated. And thirdly, delegates have been collecting and analysing samples. This last perhaps has been the most intriguing aspect of the workshop. I hope these foci have demonstrated (a) the complexity of the environmental problems that exist here as elsewhere in the world; (b) the diversity of causes from which these problems arise and (c) the need for an integrated approach in the analysis and assessment of their consequences for society as a whole. I hope also that the cummulative experience from this workshop will support a definition of the environment that transcends the physical solum to include the social context in which human beings live; and one that highlights the fact that environmental quality does not depend simply on the natural processes of the change and decay but more critically on the activities of human beings.

THE PROBLEM

My concern here is to suggest guidelines along which the information that has been gathered so far can be translated into policy through the medium of the law. An attempt to draw up guidelines suggests that we have some conception of goals,

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particularly quality goals which we want to enforce. In defining our goals we must not fall into the mistake of thinking that environmental quality goals are universal. Industrial countries are concerned mainly with the consequences of uncontrolled technological change. Although our goals must also be formulated in such a way as to enable us to avoid the predicaments which the industrial countries now find themselves in, this to us is a subsidiary issue. Our primary environmental goal is the eradication of underdevelopment: poverty, poor water, harsh climatic and ecological conditions. Put another way the primary environmental goal for the third world is to develop but in such a manner as to avoid the sort of disasters which industrial nations ended up with. Translating that goal into viable programmes will depend largely on (a) the proper choice of techniques and (b) an integrated management system.

THE ISSUE OF TECHNIQUES

The question of techniques relates to the kind of technology and technical information that is available to the third world. The most important considerations in the choice of technology and information are firstly they must be adaptable to third world conditions, secondly they must be 'clean' without being expensive, and thirdly they must be easily communicable to the general population. Adaptability is imperative. In particular I am convinced that third world countries ought to insist on technology devised from contextual sources and materials rather than borrow obsolte or inappropriate techniques from industrialized countries. Whether or not clean and cheap technology can be made available, however, is a major storm centre. But the point being made here is that the third world cannot afford to sacrifice environmental quality for the sake of rapid industrialisation per se. Communication will be essential if technology is to be used with optimum benefits to all members of society. Many third world programmes fail mainly because norm subjects do not possess the kind of information that would enable them to make the sort of decisions expected of them by the public officials.

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THE ISSUE OF MANAGEMENT

The question of management often turns on how best we can induce compliance with specified environmental goals. There are several ways in which this can be done. Firstly, it can be done by prescribing minimum standards for industrial and human conduct at the production level. This mechanism would require that before any activity is undertaken, the actual technology to be used is evaluated against specified quality standards drawn from an overall environmental policy. This would reduce but not eliminate completely the possibility of emissions of matter hazardous to the environment. But because most of the technology used in the third world are borrowed, this form of control is not only unpopular with industry; it is also very difficult to supervise. A second method widely used is the imposition of standards at the disposal or distribution level. In other words irrespective of what production techniques are used, state concern would be inter alia with the treatment of emissions and effluent, and the safety of consumer products. A third and more rational option is a structural-interventionist approach which would require industry and individuals to submit all programmes to an institution with powers to prescribe and administer standards drawn from an overall environmental policy. This is the approach which the United State government adopted in 1970 through the establishment of the National Environmental Protection Agency. Some of the factors that agency was mandated to enquire into are:

a) the environmental impact of any proposed action

b) any adverse environmental effects which cannot be avoided should the proposal be implemented;

c) alternatives to the proposed action;

d) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

e) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

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It is on the basis of an enquiry of this kind that decisions on whether the proposal should proceed are made.

THE HISTORICAL EXPERIENCE

Because environmental awareness in the third world is comparatively new, no proper management institutions as yet exist. Laws of relevance to environmental issues tend to be fragmentary and geared towards specific social utility issues rather than the attainment of environmental quality *per se*. The overall tendency is to allow industry and to some extent individuals to define their own standards and techniques of achieving it. This *laissez faire* attitude is a reflection of a dominant tendency in the national economic policy of many third world countries; namely that of unregulated competition. The theory behind unregulated competition is that through some sort of process of natural selection the market mechanism is bound to deliver only the best that society requires.

It is obvious and many jurisdictions are beginning to realize this that it is dangerous to allow industry or private individuals to be the sole judge of quality in all circumstances. It can and does lead to some obvious disasters particularly those arising from failure to look at side effects of particular programmes. For example irrigation development in this country while being hailed as the salvation for marginal areas and the Lake Victoria basin has *also* led to an increase in the incidence of malaria, bilharzia and malnutrition and the deterioration of housing quality in those areas. The same sort of problem has arisen from in discriminate and unregulated expansion of agricultural production to catchment areas and along river beds leading in the one case to reduced rainfall and in the other to rapid silting and consequent increase in flooding downstream. These problems arise precisely because industry and invididuals seldom define their objectives beyond what they consider economical. And as monopolistic practices grow, quality standards invariably deteriorate as the market mechanism becomes more and more irrelevant to the determination of consumer behaviour.

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I prefer the structural-interventionist approach as followed in the U.S.A. outlined above. Indeed a model for this type of control exists in the Agriculture Act of Kenya (Cap. 318) in relation to land preservation matters - i.e. activities such as the breaking or clearing of land for purposes of cultivation, the grazing or watering of livestock, the firing or destruction of vegetation, where these affect the condition of the soil and its fertility. In these cases there is a power to issue a land preservation order to individual or groups of producers. Failure to obey such an order exposes the violator to heavy criminal penalties as well as enabling the state at the expense of such person to enter the land and execute action contemplated by the order. But apart from the fact that this power is available only in agriculture, it is also the casesthat it has never really been vigorously prosecuted. An overall plan for industry and individual action equipped with an efficient inspectorate to ensure compliance is therefore necessary.

But the existence of a legal institution along these lines per se is not enough. At least three other requisites must be present before it can function. The first is the existence of an administrative personnel conscious of the overall centrality of environmental evaluation. The second is a competent scientific team to review new techniques, monitor changing environment situations and evaluate new conceptions of what acceptable standards are. The third is a programme of well informed education and persuasion for the general public as a whole. Without these minimum pre-conditions an environmental management institution is bound to degenerate into just another bureaucracy.

NOTICE BOARD

1. USEFUL TEXTBOOKS ON POLLUTION STUDIES

i. John W. Moore and Elizabeth A. Moore, Environmental Chemistry Academic Press, New York, San Francisco, London U.K. Edition published by Academic Press Inc. (London) Ltd., 24/28 Oval Road, London, N.W.1.

ii. Environmental Chemistry. A periodical of The Chemical Society, Burlington House, London W1V OBN.

iii. Louis Klein, River Pollution: I Chemical Analysis Butterworths Ltd., London 1959.

iv. W. Stumm and James J. Morgan, Aqua Chemistry - An Introduction Emphasising Chemical Equilibria in Natural Waters. Wiley/Interscience, London.

v. Analysis of Raw, Potable and Waste Water, Department of Environment, London HMSO

vi. D. C. Burrell, Atomic Spectrometric Analysis of Heavy Metal Pollutants in Water, Michigan, Ann Arbor, 1974.

vii. J. C. Giddings, Chemistry, Man and Environmental Change Francisco, Canfield Press 1973.

viii. International Standards for Drinking Water, A WHO Publication, Rome, 1971.

ix. P. A. Krenkel, Editor: Heavy metals in the aquatic environment, (An International Conference), Pergamon Press Limited, 1975.

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x. Philips Publications on Environmental Pollution,
Philips Organisation
Scientific and Industrial Equipment Division
Pollution Measuring Department
Building TQ 111-2, Eindhoven, Netherlands.

2. LISTS OF SOME ORGANIZATIONS/INSTITUTIONS DEALING WITH ENVIRONMENTAL POLLUTION PROBLEMS

i. Scientific Committee on Problems of the Environment (SCOPE), Secretariat
51 Boulevard de Montmorency
75016 Paris, France.

ii. Monitoring and Assessment Research Centre (MARC)
The Octagon Building, 459A Fulham Road
London SW10 OQX, England.

iii. The Registrar
International Institute for Hydraulic and Environmental Engineering (IHE), OUDE DELFT 95, P.O. Box 3015, Delft
The Netherlands

The IHE runs an annual postgraduate course in environmental science and technology for biologists, chemists chemical and agricultural engineers.

3. LIST OF SOME SCHEDULED INTERNATIONAL CONFERENCES/ SYMPOSIA/WORKSHOPS ON ENVIRONMENTAL CHEMISTRY IN 1979

Date	Place	Meeting	Contact address for further information
January	Lome, Togo	African Chemistry Laboratory Workshop	Prof. M. Adjadigba Department of Chemistry University of Benin Lome, Togo
April	Honolulu U.S.A.	Processes involving contaminants and sediments	Dr. R. A. Baker U.S. Department of Interior, Geological Survey, National Space Technology Laboratories NSTL Station, MISS 39529 U.S.A.
July	Nairobi Kenya	African Regional Network for Environmental Chemistry Workshop on pesticides Residue Analysis	Dr. S. O. Wandiga Department of Chemistry University of Nairobi Nairobi, Kenya.
July	Ibadan Nigeria	African Regional Network for Environmental Chemistry Workshop on Pesticides Residue Analysis	Dr. S. O. Ajayi, Department of Chemistry, University of Ibadan, Ibadan, Nigeria

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Date	Place	Meeting	Contact address for further information
September	Washington U.S.A.	Atmospheric input of pollutants to Natural Waters	Dr. S. J. Eisenreich Environmental Engineering Program, Department of Civil and Mineral Engineering, University of Minneapolis, 221 Church Street, S.E. Minneapolis, Minn. 55455 U.S.A.